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The Fate of Old Employees

The Evaluation of Physical Defects Found during Preemployment Examinations

The Physiology of Industrial Hygiene: III. The Physiology of Industrial Fatigue

The Development of Industrial Hygiene in Australia

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THE JOURNAL OF INDUSTRIAL HYGIENE

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THE FATE OF OLD EMPLOYEES*

W. IRVING CLARK, M.D.

Worcester, Mass.

WHEN a factory worker reaches the age of 50, there looms up in the distance a distinctly new set of problems which from this time on assume increasing importance in his life. These problems all center about his ability to continue as a valuable producer in the factory. From this time on, his earning ability depends upon his mental capacity, upon his adaptability, and upon his physical condition.

While the average workman does not become an economic problem until after the age of 65, the fifteen years prior to this date have a pretty definite effect upon his future earning capacity. By medical supervision and skilful placement during the period between the ages of 50 and 65 it may be possible to prolong a worker's highest earning capacity. By neglect of the worker during this period a much larger pension problem will probably arise in the future. The present pension problem represents the experience of companies in letting "nature take its course." The object of this paper is to review the effects of an effort to restrict the number of pensioners and, to a certain extent, to postpone the retirement of workmen who are now efficient.

In *The Nation's Health*, December, 1925, Clark and Simmons[1] reviewed the Norton Company's experience with old employees. At this time there were thirty-six workers 65 years of age or over who were carrying on some form of work in the factory, while at the same time sixteen former workers were being pensioned because of physical or mental disability.

In June, 1928, two and one-half years later, there were in the same factory thirty-nine workers 65 years of age or over, while there were on the

*Received for publication July 19, 1928.

[1] **Clark**, W. I., and Simmons, E. B.: Old **Workers** in Industry Remain in Good **Health**. **Nation's** Health, 1925, 7, 812.

pension list twenty-three former workers. Of these twenty-three, sixteen were 65 years or more and were pensioned because of "old age." The remaining seven were pensioned because of some physical disability. In two and a half years the number of pensioners has increased from sixteen to twenty-three, nearly 50 per cent., in spite of the fact that every effort has been made to keep workers off this list by medical supervision, combined with placement, and in spite of the fact that three who were placed on the list were later put on work of a type that they were able to do. In the same factory pensions started in 1920 with three on the list, and this list has now increased to twenty-three pensioners whose average age is 63 and whose average length of service is nineteen years.

Pensions are, on the whole, a compromise which is unsatisfactory both to the company, because of the rapid increase in expense, and also to the worker, because at best a pension can only eke out his savings. Few workers prefer a pension to continued work. The worker wants to keep active in factory work as long as possible because he does not like to idle. He prefers the regularity, the activity, and the companionship of a factory job to trying to find something to occupy his time at home. If, because of lack of thrift, sickness, or other misfortune, his savings are scant, the small pension which he receives is of little help in maintaining the home, and he is frequently forced to change his residence to something less expensive, or to live with one of his children—a thing which he usually does not wish to do. The fate of the poor pensioned employee is not a happy one.

How can pensions be postponed without loading the factory with inefficient workers, who after all are being paid a concealed pension as they are not earning the wages that they are receiving? It seems that the factory should adopt some such plan as the following:

1. Consider individually each of its employees over 50 years of age, and determine his working capacity. This may be done by a rating system or by comparing his work with that of younger men.
2. Keep each of its older employees in the best physical condition possible under the circumstances.
3. So arrange each man's work that he is physically able to use the large experience which he has gained during his productive years in the company.

This plan can be carried out if the Production Department, the Employment Department, and the Medical Department work with co-operative harmony, each thoroughly understanding the problem which must be met.

The Medical Department has for its function the repeated physical examination of these older men to determine whether they are fit for the work which they are doing, and, if they are not, what their physical capacity is for work in the plant.

The Production Department has for its function the investigation of these older men to see that they are employed at work which will bring them the highest return of which they are capable, thus making use of their experience and providing them with a reasonable income.

The Employment Department has for its function the transfer of those of the older men who, because of physical reasons, are unable to work any longer

in their present department to a department for which they are physically fitted, the decision as to this department being arrived at after consultation with the Health Department and the Production Department.

An effort has been made to carry out this schedule at the author's factory and a recent examination of the older employees enables us to make a comparison between the condition of the workers 65 years of age or over in 1925 and the condition of a similar group in 1928. The men in the group here studied and compared worked in twenty-four different departments in 1925, and in the same number in 1928, though the positions and the personnel differed considerably in the two periods. The type of work done is shown in Table 1.

A comparison of the 65-year group in 1925 and in 1928 shows a surprising similarity in the physical condition of the two groups (Table 2). It must be remembered, however, that the majority of the men appearing in the 1925 group also appear in the 1928 group. An analysis of the defects found shows in each group about the same amount of impairment of the organs of special sense that one would expect in men 65 years of age or over. Because of placement these defects have no effect upon the man's work.

As was noted in the previous paper, to which reference has already been made, "the condition of the mouths shows a general tendency noted in the majority of workmen to neglect the teeth in early life." There is little change in the heart situation. The condition of the hearts in the 1928 group is quite as satisfactory as it was in the 1925 group, and the same state-

TABLE 1.—COMPARISON OF TYPES OF WORK PERFORMED BY EMPLOYEES 65 YEARS OF AGE OR OVER IN 1925 AND IN 1928

TYPE OF WORK	NO. OF MEN
1925	
Elevator operator	3
Sweeper	2
Foreman	4
Draftsman	1
Carpenter	2
Chipper	2
Checker	2
Guard	2
Machinist	4
Molder and mixer	2
Ring handler	1
Packer	2
Stone rubber	1
Inspector	2
Mason	1
Tool work	3
Experimental work	1
Painter	1
Total	36
1928	
Elevator operator	2
Sweeper	3
Foreman	4
Assistant foreman	2
Carpenter	3
Guard	2
Machinist	2
Molder	1
Tool work	1
Instructor	2
Cutter out of wheels	1
Millwright	2
Oiler	1
Wheel sorter	2
Reamer	1
Truer	2
Balancing	1
Laboratory	1
Operator	1
Clerk	1
Fireman	1
Planer	1
Wheel chaser	1
Messenger	1
Total	39

ment may be made as to the lungs, abdomen, and upper extremities. It is does not appreciate these slow changes and feels as capable of working as ever.

TABLE 2.—COMPARISON OF PHYSICAL CONDITION OF EMPLOYEES 65 YEARS OF AGE OR OVER IN 1925 AND IN 1928

	1925	1928		1925	1928
Number	36	39	Protuberant	24	19
Age:			Postoperative scar	1	1
Average	68	68	Upper Extremities:		
Oldest	79	78	Normal	31	37
Youngest	65	65	Old fracture	0	1
Height (in.)	65½	66¾	Varicosities	2	2
Weight (lb.)	146⅝	156	Chronic rheumatism	2	0
Eyes:			Mutilation	1	0
Normal	5	3	Lower Extremities:		
Defects	31	36	Normal	21	13
Ears:			Flatfoot	15	20
Normal	9	10	Varicosities	5	11
Deafness, moderate	6	19	Hallux valgus	1	0
Deafness, severe	21	10	Chronic rheumatism	1	0
Nose:			Inguinal Region:		
Normal	19	33	Normal	26	34
Deviated septum	18	6	Hernia	10	5
Throat:			Genito-Urinary Tract:		
Normal	17	17	Normal	20	28
Congested	18	20	Hydrocele	4	2
Large uvula	1	2	Varicocele	11	9
Teeth:			Enlarged testes	2	2
Good	1	0	Atrophied testes	1	0
Fair	2	2	Spine:		
Poor	23	19	Normal	34	34
Missing	10	18	Kyphosis	2	5
Neck:			Skin:		
Normal	36	39	Normal	31	37
Heart:			Moles	1	0
Normal	25	31	Nevi	1	0
Murmurs	7	7	Warts	1	0
Irregularity	4	4	Eczema	1	0
Lungs:			Lipoma	0	1
Normal	26	34	Alopecia	0	1
Emphysema	8	4	Reflexes:		
Bronchitis (chronic)	2	1	Normal	36	39
Abdomen:			Blood Pressure:		
Normal	12	19	Average	142/83	144/85

not in any one organ that the old employee seems to fail. It is in his slowing mentality, in his inability to maintain a piecework pace, and in his lack of muscular strength. The older worker It is because of this that placement changes are a little difficult to make and the final retirement comes as a surprise and a disappointment. We may, therefore, say that in the factory

where this study was made the physical condition of the workers 65 years of age or over is about the same from year to year. Although each year men are pensioned or die, those taking their places show about the same physical picture.

It is also evident from Table 1 that there are at least thirty-two types of position in the factory which may be filled by old workers with profit to themselves and to the company.

In this particular factory there is an allowance fund which is drawn upon to pay the worker the difference between what he actually earns and the amount that he is paid. This allows the employment of men who are slightly inefficient without there being a hidden charge against production. The fact that of thirty-nine men 65 years of age or over only three are unable to earn fully the wages paid them, shows the good working ability of the present group.

Conclusions

In a factory of 2,500 employees, established since 1885, an investigation of the workers 65 years of age or over and of the pensioners suggests the following conclusions:

1. While pensions are necessary, they are satisfactory neither to the worker nor to the company and should be postponed as long as possible.
2. Through medical supervision and careful placement, older workmen may be kept at work which is of value to them and to the company.
3. The physical condition of a group of workers 65 years of age or over varies little from year to year.
4. Careful medical supervision between the ages of 50 and 65 should reduce the number of workers ultimately placed on the pension list.

THE EVALUATION OF PHYSICAL DEFECTS FOUND DURING PREEMPLOYMENT EXAMINATIONS*

C. O. Sappington, M.D., Dr.P.H.

Medical Director, Montgomery Ward and Company, Oakland, Calif.

THE analysis of data involving the collection and tabulation of physical defects is a subject which presents both interesting possibilities and complex ramifications.[1] A variety of questions immediately present themselves:

What is a physical defect?

How may physical defects be classified?

What is the relation of defects to the incidence of sickness, accidents, and absenteeism?

What part do age, sex, and occupation play in the evaluation, evolution, and involution of physical defects?

Are health habits related to physical defects?

What of the degrees of severity, persistence, and correctability?

We are accustomed to assigning a grade to intelligence. Can we grade a given individual according to his physical defects?

A casual survey of this list of questions will give some idea of the difficulties which one might expect to encounter in the attempt to set down a definite experience related to the occurrence of physical defects. Fortunately such an experiment has already been conducted by Dr. D. F. Smiley,[2] Medical Adviser at Cornell University. Using health habits and physical defects as a basis, Smiley has invented and used a numerical rating scale. This grading table has been modified to meet the needs of the mercantile group with which it has been used in the present study.

Rating Scale

1. History of serious illness.
2. History of major operation.
3. History of dysmenorrhea.
4. Not vaccinated within the past five years.
5. Loss of over one week from work within the past year.
6. Malnutrition (underweight or overweight 10 per cent.).
7. Rapid pulse (above 84).
8. Rise in temperature.
9. Palpable and visible enlargement of thyroid.
10. Defective vision uncorrected.
11. Deafness or discharging ears.
12. Nasal defects (deviated septum, hypertrophied turbinates, chronic sinusitis, etc.).
13. Defective teeth (carious, pyorrhea).
14. Enlarged and infected tonsils, needing removal.
15. Râles or temporary lung congestion.
16. Hernia.
17. Varicose veins.
18. Abnormal genitals (phimosis, varicocele, hydrocele).
19. Improper posture (stoop neck, round hollow back, drop shoulders).
20. Poor foot mechanics (relaxed transverse arches, flatfeet 1°, 2°, or 3°, bunions, corns, pronation).

* Received for publication July 21, 1928.

[1] Sappington, C. O.: Industrial Morbidity Data and the Physician. Am. Jour. Pub. Health, 1927, *17*, 711.

[2] Smiley, D. F.: Organization of the Health Program of a University. U. S. Pub. Health Rep., 1926, *41*, 2631.

A defect found under each numbered item caused a demerit of 5 points, which was subtracted from the perfect score of 100.

TABLE 1.—EXAMINATION CLASSIFICATION ACCORDING TO AGE AND SEX

CLASSIFICATION	AGE GROUP						TOTAL
	10–19	20–29	30–39	40–49	50–59	60+	
Males							
Accepted	56	45	23	8	5	0	137
Provisional	68	54	7	10	3	1	143
Rejected	2	3	1	1	2	0	9
Total	126	102	31	19	10	1	289
Females							
Accepted	39	45	14	1	0	0	99
Provisional	51	59	10	6	0	0	126
Rejected	1	0	0	0	0	0	1
Total	91	104	24	7	0	0	226
All Persons							
Accepted	95	90	37	9	5	0	236
Provisional	119	113	17	16	3	1	269
Rejected	3	3	1	1	2	0	10
Total	217	206	55	26	10	1	515

Comments on Rating Scale

Because of local conditions in our medical department it was not possible to collect and set down the health habits of examinees as Smiley had done in his work at Cornell. In lieu of this we substituted certain points in the history and other findings which might be the cause of substandard physical conditions, or might lead to inefficiency or absenteeism.

Among such items were: history of serious illness; history of major operation; history of dysmenorrhea; not vaccinated within the past five years;[3] and loss of over one week within the past year. There are other definite physical defects which have not been included in the list, largely because previous experience has shown that they occur in such small numbers as to be statistically insignificant, at least in this particular group of employees.

Comments on Data

Table 1, giving the age and sex grouping of the 515 persons examined, shows that 56.1 per cent. were males

[3] Vaccination immunity is usually considered to last from seven to ten years. In California there is a large unvaccinated population; smallpox is endemic.

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16. Hernia.
17. Varicose veins.
18. Abnormal genitals (phimosis, varicocele, hydrocele).
19. Improper posture (stoop neck, round hollow back, drop shoulders).
20. Poor foot mechanics (relaxed transverse arches, flatfeet 1°, 2°, or 3°, bunions, corns, pronation).

* Received for publication July 21, 1928.

[1] Sappington, C. O.: Industrial Morbidity Data and the Physician. Am. Jour. Pub. Health, 1927, *17*, 711.

[2] Smiley, D. F.: Organization of the Health Program of a University. U. S. Pub. Health Rep., 1926, *41*, 2631.

A defect found under each numbered item caused a demerit of 5 points, which was subtracted from the perfect score of 100.

TABLE 1.—EXAMINATION CLASSIFICATION ACCORDING TO AGE AND SEX

CLASSIFICATION	AGE GROUP						TOTAL
	10–19	20–29	30–39	40–49	50–59	60+	
Males							
Accepted	56	45	23	8	5	0	137
Provisional	68	54	7	10	3	1	143
Rejected	2	3	1	1	2	0	9
Total	126	102	31	19	10	1	289
Females							
Accepted	39	45	14	1	0	0	99
Provisional	51	59	10	6	0	0	126
Rejected	1	0	0	0	0	0	1
Total	91	104	24	7	0	0	226
All Persons							
Accepted	95	90	37	9	5	0	236
Provisional	119	113	17	16	3	1	269
Rejected	3	3	1	1	2	0	10
Total	217	206	55	26	10	1	515

Comments on Rating Scale

Because of local conditions in our medical department it was not possible to collect and set down the health habits of examinees as Smiley had done in his work at Cornell. In lieu of this we substituted certain points in the history and other findings which might be the cause of substandard physical conditions, or might lead to inefficiency or absenteeism.

Among such items were: history of serious illness; history of major operation; history of dysmenorrhea; not vaccinated within the past five years;[3] and loss of over one week within the past year. There are other definite physical defects which have not been included in the list, largely because previous experience has shown that they occur in such small numbers as to be statistically insignificant, at least in this particular group of employees.

Comments on Data

Table 1, giving the age and sex grouping of the 515 persons examined, shows that 56.1 per cent. were males

[3] Vaccination immunity is usually considered to last from seven to ten years. In California there is a large unvaccinated population; smallpox is endemic.

and 43.8 per cent. were females; 42.1 per cent. were under age 20 and 82.1 per cent. under age 30; 52.2 per cent. were provisionally accepted and only 1.9 per cent. were rejected.

TABLE 2.—PRINCIPAL DEFECTS FOUND IN 515 PHYSICAL EXAMINATIONS

DEFECTS	INCIDENCE AMONG			
	Males %	Females %	All Persons	
			No. of Cases	%
Improper foot mechanics	74.7	65.0	363	70.5
Not vaccinated in past 5 years	61.2	64.2	322	62.5
Underweight (more than 10%)	51.2	50.4	262	50.9
History of serious illness	37.7	34.5	187	36.3
Faulty posture	15.2	30.5	113	21.9
Carious teeth	20.0	7.7	76	14.7
Lung conditions	19.0	9.3	76	14.7
Rapid pulse (above 84)	9.0	20.8	73	14.2
Enlarged and infected tonsils	14.9	9.7	65	12.6
Rise in temperature	7.9	16.4	60	11.6
Defective vision uncorrected	11.1	9.3	53	10.3
History of dysmenorrhea	...	8.5	44	8.5
History of major operation	6.1	6.5	37	7.2
Abnormal genitals (phimosis, varicocele, hydrocele)	6.0	...	31	6.0
Loss of over 1 week in past year	5.2	6.2	29	5.6
Overweight (more than 10%)	5.5	4.0	25	4.8
Enlarged thyroid	0.4	8.4	20	3.9
Deviated septum	0.3	0.3	15	2.9
Varicose veins	...	...	5	0.9
Hernia	...	...	2	0.3

Table 2 exhibits defects which one would expect to find in a group largely made up of young persons. Rather interesting differences are shown in the percentage occurrence of abnormalities in the two sexes.

Table 3 sets forth the numerical scores tabulated according to age group and sex. The range was from 100 per cent. to 50 per cent., the average being 80.8. These scores represent a figure expressing the *number* of defects rather than their severity. (For instance, a hernia is equal to faulty posture as far as the resulting demerit is concerned.) The last column of this table shows the percentage distribution of scores by sex. The mode falls at 85 for both sexes and all persons.

Table 4 gives a comparison of the scores of male employees and university men. As was expected, the university men showed a greater percentage of those having higher scores with the mode at 95.[4]

In Table 5 the average scores are compared with the average number of defects per person. One would ex-

[4] These results were obtained from personal correspondence with Dr. Smiley.

pect a fairly high positive association between these two factors, *i.e.*, low number of defects and high score (as the ratings were made on a quantita-

TABLE 3.—DISTRIBUTION OF INDIVIDUAL SCORES BY AGE AND SEX

SCORE %	AGE GROUP						TOTAL	
	10–19	20–29	30–39	40–49	50–59	60+	No.	%
				Males				
100	1	0	0	0	0	0	1	0.3
95	7	5	0	0	0	0	12	4.1
90	28	23	5	5	2	0	63	21.8
85	32	21	10	2	2	0	67	23.1
80	23	24	4	9	1	0	61	21.1
75	19	19	7	1	1	0	47	16.2
70	13	5	5	2	1	0	26	8.9
65	3	3	0	0	1	0	7	2.4
60	0	1	0	0	0	1	2	0.6
55	0	1	0	0	1	0	2	0.6
50	0	0	0	0	1	0	1	0.3
Total....	10,375	8,335	2,495	1,555	745	60	289	....
				Females				
95	4	3	0	0	0	0	7	3.0
90	18	14	3	1	0	0	36	15.9
85	19	23	5	2	0	0	49	21.6
80	18	22	4	1	0	0	45	19.9
75	18	23	7	1	0	0	49	21.6
70	11	12	3	2	0	0	28	12.3
65	2	5	2	0	0	0	9	3.9
60	1	2	0	0	0	0	3	1.3
Total....	7,365	8,270	1,880	555	0	0	226	....
				Both Sexes				
100	1	0	0	0	0	0	1	0.1
95	11	8	0	0	0	0	19	3.6
90	46	37	8	6	2	0	99	19.2
85	51	44	15	4	2	0	116	22.5
80	41	46	8	10	1	0	106	20.5
75	37	42	14	2	1	0	96	18.6
70	24	17	8	4	1	0	54	10.4
65	5	8	2	0	1	0	16	3.1
60	1	3	0	0	0	1	5	0.9
55	0	1	0	0	1	0	2	0.3
50	0	0	0	0	1	0	1	0.1
Total....	17,740	16,605	4,375	2,110	745	60	515	....

Average = 80.8. Mode = 85. Median = 85.

tive basis). A discrepancy does exist, however, and was probably mainly produced by the number of persons in each age and sex group.

TABLE 4.—COMPARISON OF SCORES OF UNIVERSITY MEN WITH SCORES OF EMPLOYEES

SCORE %	UNIVERSITY MEN %	MERCANTILE MEN %
100	24.0	0.3
95	34.9	4.1
90	22.4	21.8
85	13.3	23.1
80	3.9	21.1
75	0.8	16.2
70	0.2	8.9
65	0.0	2.4
60	0.6	0.6
55	0.0	0.6
50	0.0	0.3

The highest average score occurred in males in the age group 10 to 19; the lowest, in males 50 to 59. The highest average number of defects occurred in males 50 to 59; the lowest, in males 10 to 19.

Summary and Conclusion

A grading scheme adapted to the assigning of a numerical value to persons possessing physical defects has been devised. The scale has been based on previous findings and adjusted for use in this particular group. The values used have been considered only from the standpoint of the frequency of occurrence of physical defects, no account being taken of severity, persistence, or correctability. Neither have we assayed the relative importance of such factors as working efficiency, sickness, accident occurrence, absenteeism, or health habits.

TABLE 5.—COMPARISON OF AVERAGE SCORES WITH AVERAGE NUMBER OF DEFECTS PER PERSON BY AGE AND SEX

	AGE GROUP					TOTAL
	10–19	20–29	30–39	40–49	50–59	
Males						
Average score	82.3	81.7	80.4	81.8	74.5	81.5
Average number of defects per person	3.5	3.6	3.9	3.6	5.1	3.6
Females						
Average score	80.9	79.5	78.3	79.2	...	79.9
Average number of defects per person	3.8	4.1	3.9	4.8	...	4.0
All Persons						
Average score	81.7	80.6	79.5	81.1	74.5	80.8
Average number of defects per person	3.6	3.8	4.1	3.7	5.1	3.8

A comparison of our results with the results of a similar study in uni-

versity men shows the occurrence of higher scores in greater numbers among university men.

The applicability of any such system of numerical grading would probably vary with the type of work in the plant concerned, the age incidence of the personnel, the sex distribution, and perhaps the geographic location of the business. Local peculiarities would probably necessitate special adjustments. Apparently a standardized scheme would be a difficult possibility.

The practical value of grading persons in terms of their physical defects is somewhat doubtful. More work must be done and a more careful evaluation of the various complex factors concerned must be accomplished before a scientific basis can be reached. The subject will probably be of sufficient importance in future years, however, to warrant such study and it is hoped that this small experience will be the incentive to more productive efforts.

THE PHYSIOLOGY OF INDUSTRIAL HYGIENE: III. THE PHYSIOLOGY OF INDUSTRIAL FATIGUE*

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ALTHOUGH fatigue is an everyday phenomenon and in some respects is simple from the elementary physiologic point of view, from many of its more practical aspects it is so difficult that as yet much of it is beyond our knowledge. The more we know of this complicated subject, the more it becomes evident that fatigue is of two main kinds, muscular and nervous.

Muscular Fatigue

Our knowledge of this subject we owe largely to work on the classic nerve-muscle preparation of the frog, the muscles and nerves of which continue to survive for a considerable period after the animal has been killed and the parts removed from the body. If the nerve is repeatedly stimulated with an electric current, the contractions of the muscles, if recorded, gradually become weaker and weaker, till they fail altogether; but if the muscle be then stimulated directly, it is found that it still contracts, although very much less than it did originally. It is evident, then, that although some fatigue has occurred in the muscle itself, the complete failure to contract when the nerve is stimulated is due to some part of the nervous mechanism. If, however, a small portion of the nerve of a nerve-muscle preparation be blocked by freezing or by anesthesia close to the muscle, it is found that repeated stimulation of the nerve above the block does not apparently affect its efficiency. We may consider, in the ordinary sense, that nerve fibers cannot be fatigued. The initial failure of a nerve-muscle preparation to respond, therefore, is due to fatigue in the region of the nerve ending or neuromuscular junction.

This is the classic explanation of fatigue, but of recent years the work of Lapicque has emphasized changes in the muscle. He has pointed out that a muscle will respond to a stimulus of a certain strength and duration (chronaxia) and that normally this stimulus is supplied by the nerve. When, however, a muscle is fatigued he finds that it changes its chronaxia and cannot be stimulated by certain currents. The state may well be compared with the more familiar reaction of degeneration in muscles after section of their nerves. In such circumstances the muscle has so changed its chronaxia that it can no longer be excited by a faradic current although it still responds to a galvanic current. In his explanation, therefore, the apparently local fatigue at the nerve ending is really due to failure of the normal

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stimulus to excite the muscle generally.

This neuromuscular fatigue, however, is essentially muscular in origin, in that it definitely depends on the accumulation of fatigue products, such as lactic acid, in the muscle. If the experiment has been carried out in the absence of oxygen, that is, under circumstances when the lactic acid accumulates all the more rapidly, the onset of fatigue is accelerated.

On the other hand, if the experiment is carried out on an animal it may be shown that the time of onset of fatigue is affected appreciably by the efficiency of the blood supply. If two legs be stimulated simultaneously, the circulation to one of them being tied off, fatigue occurs much earlier in the muscles without the blood supply.

The fatigue which occurs in heavy muscular work is of this kind, and if we study the work curves of individuals doing such work, it is evident that there is a steady reduction of efficiency. A recovery of efficiency can be achieved by physical rest. It might be emphasized that fatigue of a large amount of muscle in the body may reduce the efficiency of parts which have not actually been used. Hence, the great importance in industry of reducing as far as possible the movement of the muscles of the trunk, which not only produce lactic acid but, as described in the previous article in this series (1), demand in virtue of their activity an increased blood supply. This lactic acid may affect distant muscles and less blood is available elsewhere.

In exercise the lactic acid is produced in the muscle from the breakdown of carbohydrate. This lactic acid is, normally, partially built up again into carbohydrate and partially oxidized to the ultimate products—carbon dioxide and water. The classic experiment on the point is that of Fletcher and Hopkins (2), who showed that although a muscle could contract in the absence of oxygen it would not recover without it. This requirement of oxygen for full recovery is of fundamental importance in relation to exercise. It will be seen also that by such a mechanism the fresh muscle is enabled to contract although oxygen is not immediately available.

In the intact animal the necessary oxygen supplied by the circulation is practically never sufficient to supply all the oxygen needed for the exercise within the period of the exercise. The muscle is said to go into oxygen debt (3). This is really an adaptation by which the muscles, and the body in general, can meet emergencies, as it permits a large amount of muscular work to be done and the oxygen to be taken in later when the emergency has passed. We can, no doubt, recall the breathlessness which succeeds for some time a sharp bout of exercise. The general accumulation of lactic acid in the body is responsible for the discomfort of the breathlessness caused thereby; but local accumulation of lactic acid may also occur.

It is important to consider for a moment what happens if the activity is persisted in. The condition of affairs is summed up in the classic words of J. S. Haldane: "Lactic acid not only stops the machine, but wrecks the machinery." There is ample evidence that mammalian tissues are liable to be killed by lactic acid. Indeed, if this is prevented from accumulating

at death, even mammalian tissue can be kept alive and irritable for many hours (4).

This wrecking of the machinery can be demonstrated on an isolated frog muscle. If the muscle is made to lift a weighted lever, it can readily be shown that in order to get the maximum amount of work out of a muscle in a given time it should never be completely fatigued.

This fact can also be demonstrated on human muscle, although it must not be presumed that human fatigue is necessarily wholly dependent on conditions in the muscle.

It cannot be overemphasized that there is a considerable initial variation in muscle in this respect, but that all may become approximated by the process of training. We are all familiar with the fact that an untrained muscle becomes more readily fatigued. This we may believe to be due to the less efficient circulation through such a muscle, and to the increased liability, therefore, for metabolic products to accumulate. These attract water, by the physical process of osmosis, and the muscles swell. This swelling inside the fibrous sheath of the muscle compresses the muscle spindles to produce stiffness or actual pain if the muscle is used.

Having mentioned the matter of rest, we may well be asked how long and how many these pauses ought to be. The rest pauses, it has been shown, should, as far as possible, be spread out over the work period; and, on theoretical grounds, the longest period of work should be when the muscles are fresh. Clearly, however, there is a limit to the extent, but what this limit is can be determined only by trial and error.

If we apply the foregoing facts to the prevention of fatigue in industry, we see that a primary consideration must be not only a reduction of the amount of muscle used, but also a decrease of lactic acid production in other ways. It has been pointed out by Fick, and more recently by A. V. Hill (3), that a muscle wastes a large amount of its energy in the internal work of overcoming its own viscosity. The more rapid the movement the less economical the muscle is, and the slower the movement the less waste of energy there is in overcoming this resistance. Similarly, on commencing to contract, the inertia of the part has to be overcome, and there is a further waste of energy. From the point of view of economy, therefore, movements should not be jerky, but rhythmic and smooth, so that automatically one leads to the other.

It must be quite understood that what has been said above applies primarily to severe and continued physical work, although some of the principles apply also to more highly skilled work.

Nervous Fatigue

It is quite evident that many other factors enter into the production of fatigue due to rapidly repeated voluntary movement, for it can be demonstrated that if the finger is moved for as long as can be, the muscle may still be stimulated electrically through its nerve, or directly. The inability to move the muscle voluntarily does not depend on actual local fatigue of the muscle or of the nerve ending, but is somewhat of the nature of fatigue in the higher centers. It has been suggested by Reid (5) that local conditions in the muscles, by setting up afferent

impulses, bring about an inhibition of the voluntary effort. This possibility is supported by the work of Denny-Brown (6), in Sherrington's laboratory, who brings forward evidence that the muscle spindles send up inhibitory stimuli; whereas the tendon organs originate afferent excitatory stimuli. This matter is also of considerable popular interest as it gives an explanation of why individuals under considerable mental stress—*e.g.*, lunatics—may perform prodigious feats of strength. In such circumstances it may well be considered that inhibitory stimuli from the muscles are ineffective and the individual brings into operation a large number of muscle fibers which are normally kept in reserve by the inhibitory mechanism. On the other hand, it is just as possible that the fatigue results from the excessive use of certain synapses in the brain or the spinal cord. We know from the work of Sherrington (7) that the synapses, or junctions between nerve units, in the spinal cord are very liable to a fatigue, which, however, is rapidly reversed. A similar state occurs, no doubt, in the higher parts of the brain, and we know that fatigue occurs as a result of excessive mental effort. A disappearance of the Nissl granules of the nerve cells has been described, and whether or not the granules are themselves artifacts, the fact that there is a difference in the fatigued and the unfatigued cells is not disproved and indicates that the nerve cell has undergone change during activity.

Whatever the ultimate nature and seat of fatigue of voluntary effort, it must be emphasized that the facts gleaned from experiments on isolated nerve muscle have been shown definitely to apply to voluntary movement. The rest pauses are as likely to be beneficial to the nerve centers as to the muscles.

All muscular activity does not, however, result in impairment of efficiency. The phenomenon of practice efficiency, by which the efficiency of the individual increases as the work proceeds, is well recognized. On reviewing the various trades in which such increased efficiency is well marked, it is evident that it occurs in the more highly skilled manual occupations involving co-ordinated nervous activity. It is to be observed also that the oftener a voluntary movement is repeated, the less voluntary and the more automatic or reflex it becomes. A similar state occurs in the case of the reflexes of a decerebrate animal, and has been shown by Sherrington to be due to a reduction in the resistance of the synapses through which the impulse has to pass. This is known as facilitation. Practice efficiency may well be due to a similar facilitation in the nerve synapses concerned in the carrying out of skilled movements. It would seem that as a movement is repeated the muscles which are not essential cease to be used. This fact in a running animal contributes to the phenomenon of second wind. It is of interest in this aspect to add that the extent to which muscles may become set for certain tasks is illustrated by the Marathon runner, who is not necessarily a very proficient walker. This fact is of importance in the prevention of fatigue in athletic events, as it indicates most clearly that the best training for a certain event is to practise that event. There is, then,

some evidence to suggest an adaptation to certain rates of movement.

In some highly skilled occupations, practice efficiency continues thus to be evident throughout the day and rest pauses result in a reduced efficiency, but more commonly there is an initial increase in efficiency, due to practice, followed by fatigue, just as occurs in a long distance race (8). Monday inefficiency is in fact partly due to loss of practice efficiency.

It is not to be supposed that what has been said above covers the whole of the factors concerned in fatigue production. Many other considerations must be taken into account, such as temperature, moisture, interest, and monetary considerations, and a vast number of social and home conditions which influence work curves. We cannot, therefore, consider that a given fall in output is necessarily due to fatigue. Factors concerning the circulation have been discussed in a previous paper.

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THE DEVELOPMENT OF INDUSTRIAL HYGIENE IN AUSTRALIA*

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THE term industrial hygiene is capable of varying definition, according to the conception of the objective. On the one hand it may be restricted to the recognition of hazards inherent in industry and the measures that can be adopted to reduce or remove the noxious influences. On the other hand it may be taken to include all factors appertaining to the health of the industrial community. The latter conception would bring industrial hygiene into line with general hygiene with the one difference that the etiologic elements of disturbed health encountered in the home, in the street, in places of amusement, and in places of assembly are excluded. The modern employment of the term tends toward the wider definition, and in this attempt to follow the evolution of industrial hygiene in Australia from its earliest beginnings to the present time it will be used in this sense.

It must be realized that in Australia, as in many other countries, the employer with but few exceptions is not concerned with the health of individual workers except in relation to their employment. If the worker is engaged at a weekly wage, ill health may reduce his rate of production; in consequence it is in the direct interest of the employer to adopt means to keep him healthy. The very high cost of labor and the relatively small markets set a limit to the contribution which the average employer is prepared to make to achieve this end. Some employers stop wages when an employee is absent on account of illness or for any other reason; others pay wages for a short time. Recent amendments of the Workers' Compensation Acts in the several states of the Commonwealth have influenced employers to stop payment during absence from work when compensation can be claimed under the provisions of the legislative measures. If a worker is found to be suffering from pulmonary tuberculosis or from other serious chronic disease, he loses his position and the employer ceases to take any further interest in his welfare. In these and analogous conditions, problems of industrial hygiene may extend far beyond the workshop, factory, or place of business. Industrial hygiene therefore concerns, in addition to the employers and their agents, the legislature, the health department, the trade-unions, the voluntary bodies concerned with the care of persons suffering from various infective and noninfective diseases, the semiofficial organizations combating disease, and the charitable and other institutions offering medical and surgical treatment for persons in need of this treatment.

Early History

Australia formerly comprised six colonies, each of which enjoyed some degree of autonomy. Each colony

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guarded its borders as strictly as do contiguous foreign countries. Custom duties were levied on goods sent over the borders and quarantine restrictions were at times imposed on one side of a border and not on the other. In those days the departments of public health known under varying names endeavored to preserve the health of their respective communities in accordance with ruling views. Little if any attention was given to the conditions of labor from a health point of view until the end of last century. A few firms at that time retained the services of private medical practitioners to treat employees who were taken ill at the place of business or who needed first aid after injury. These practitioners had no concern with the hygienic arrangements of the establishments or with the health hazards of the trade. They confined their activities to the treatment of illness or injury in emergency. In 1893 an inquiry was instituted by the Board of Health of New South Wales into the causes of lead poisoning in the mines at Broken Hill and the best means of prevention. The result of this inquiry was the introduction of special regulations under the Mines Inspection Act, with the object of preventing lead poisoning in miners and smelters. A few similar investigations led to the adoption of measures calculated to mitigate the defects discovered.

When the colonies were federated in 1901, the Commonwealth was given control over quarantine arrangements of ships arriving in Australian waters and, in the event of outbreaks of specified dangerous infections, even over arrangements between the several states. The Quarantine Department had powers to prevent persons suffering from tuberculosis, leprosy, and various other diseases from landing in Australia, but the states individually and collectively refused to concede any of their rights in regard to internal public health administration. The Acts at that time were antiquated, clumsy, and far too complicated. The control was, to a large extent, a sanitary one and the authorities were inclined to rely on orthodox measures rather than to evolve new plans and to develop new ideas. There was no factory branch of any of the health or other departments of the states. Some progress, however, was made as a result of the initiative of individual heads of the departments. In 1902 a departmental committee investigated the risks incurred in the boring of sewer tunnels through sandstone in the neighborhood of Sydney. In 1904 a Royal Commission was appointed in Western Australia to inquire into the working conditions of the mines and to suggest remedies for the defects found. As a result a special board was appointed to watch lest pneumonokoniosis and pulmonary tuberculosis should become frequent among miners. A similar inquiry was carried out in Bendigo in Victoria in the year 1906. Other commissions and departmental committees of inquiry into the health hazards in mines, sewerage works, and so forth were appointed in the years before the war, ending with a Royal Commission in 1914 to inquire into the prevalence, nature, and prophylaxis of pneumonokoniosis at Broken Hill and into the question of lead poisoning among miners.

At this stage the Post Office under the control of the Commonwealth gov-

ernment employed full time medical officers in the larger of the capital cities, not only for the purpose of providing treatment in emergency, but also to regulate the health factors in the Department. An attempt, albeit somewhat crude and limited, was made to maintain a reasonable standard of health among the employees of the Post Office. The Railways and Tramways of New South Wales employed two medical officers whose duties included, in addition to the testing of engine drivers and others for acuity of vision and for color sense, the examination of everyone joining the service and the control of the causes of absence from duty. Masses of information of potential value were accumulated, but no attempt was made to put this material to practical use for many years.

Long before the war Dr. J. Lockhart Gibson, of Brisbane, called attention to many infants and children who became blind without obvious cause. Dr. Gibson attributed this blindness to lead, the source of which he traced to paint on outside woodwork and veranda railings. He started a campaign against the use of lead in paint and persisted, in spite of much opposition and many impediments, until the Queensland government introduced legislation restricting the inclusion of lead in paints for certain purposes. Dr. Gibson's work, whether it was based on reliable evidence or not, commands the attention of all who have followed it, for it certainly has resulted in the recognition of a potential danger to health of the community and incidentally it has improved the conditions obtaining in paint factories.

Later Developments

Although the Commonwealth government had no immediate control of measures for the prevention of disease, it became apparent in the early days that a great deal could be accomplished by precept, initiation, and offers of help by co-ordination of the several authorities. Some twelve or thirteen years ago the International Health Board of the Rockefeller Foundation issued a world wide invitation to governments to co-operate in a campaign to eradicate hookworm and other intestinal infections. The Commonwealth government recognized the great advantages that would accrue by the institution of a campaign of this kind and accepted the offer. At first the survey was undertaken in federal territory only. Dr. Waite and a representative of the Quarantine Department started work in New Guinea in the year 1917. In 1918 pressure was put on the Queensland government to enter into a triangular arrangement with the International Health Board and the Commonwealth government whereby the hookworm survey could be extended to the state of Queensland. The governments of the other states almost reluctantly fell into line and eventually the survey was extended through the length and breadth of the land.

After a time the proposal was put forward by the Commonwealth government that experts in industrial hygiene, sanitary engineering, and tropical medicine should be loaned to the Commonwealth government in order that work in these directions might be inaugurated. It was probably antici-

pated by those in authority that if departments could be established as an outcome of these arrangements, fuller powers would be accorded the Commonwealth government. At all events Dr. A. J. Lanza, industrial hygiene expert of the International Health Board, arrived in Australia in 1921 and together with Dr. D. G. Robertson started the first serious work in this chapter of preventive medicine.

At first it was necessary to determine the actual state of affairs in the several states of Australia. Statistics were discovered in large industries. Plans were drawn up for the collection of further records and advice was given concerning the establishment of industrial health services in large factories and in industrial undertakings. A great deal of very valuable information was collected, ordered, and placed in readiness for utilization as the occasion might arise. In 1920 the Commonwealth government created a Department of Health with the special function of co-ordinating the activities of the state health authorities and of inciting the latter to widen the scope of their health work. The Division of Industrial Hygiene was established in 1921 and in 1923 the American experts were withdrawn.

The Division soon gained the complete confidence of the medical profession and of the community. As it has no substantial legislative powers, it is compelled to exercise its influence by persuasion and by voluntary appeal. A general invitation was issued to the governments of all the states and to industrial undertakings to accept its assistance in the endeavor to improve the hygienic conditions of the workers. Conferences were called by the Prime Minister of Australia with representatives of the health departments of the states. The first conference took place in 1922. At this meeting it was determined to concentrate the attention of those participating on the conditions of child and female labor, on the question of the notification of occupational disease, on factory inspection, on hygienic standards, and on morbidity statistics. The following, *inter alia*, are resolutions adopted by the conference. They are reproduced to indicate the need for reform as judged by the individual permanent heads of departments at the time when co-ordinated effort was being initiated.

1. That in the opinion of the Conference all persons employed in factories and workshops should be medically examined before employment and in each year of employment until the person has completed his or her eighteenth year.

That a certificate of fitness should be furnished on initial employment in each case at or under the minimum statutory age for employment.

That medical examinations should be made more frequently than annually if the medical examiner considers this necessary in any individual case.

That all medical examinations should be made by specially authorized medical officers.

2. That standardized record cards for every examination performed should be kept by the medical examiners, and these records should be available at each re-examination.

3. That the medical records of the Education Departments should be available to the authorized medical inspectors in respect of any child seeking employment in factory or workshop.

4. That it is desirable that the legislation in all the States prescribing the minimum age for employment be made uniform.

5. That the minimum age for employment in factories and workshops be not under fourteen years for boys and fifteen years for girls.

6. That the Division of Industrial Hy-

giene of the Commonwealth Department of Health take steps to acquire all available information necessary to enable recommendations to be formulated in regard to paragraphs 1 and 2 of page 8 of the Conference Agenda (quoted in page 7 of this Report, under heading "Points for Consideration").

7. That it is desirable that each State should have in effective operation legislation controlling occupations dangerous to the health of those employed therein.

8. That all occupational diseases should be notifiable by medical practitioners and that notifications should be made direct to the Health Department of the State.

9. That in the opinion of this Conference factory medical inspectors should be appointed.

10. It is the opinion of this Conference that it is very desirable that there should be collection of morbidity and accident statistics upon uniform lines and that the Commonwealth Statistician be asked to draft a uniform scheme.

11. That it is desirable that a committee should be appointed to draw up standards of qualification for factory inspectors and the nature of the course of study necessary before such qualification can be obtained.

12. That in the opinion of this Conference the provisions of the *Factories and Workshops Acts* should extend to factories carried on or conducted by the Government or by any Local Authority as well as to factories otherwise carried on or conducted.

13. This Conference considers that in view of the importance, as a phase of public health administration, of systematic medical supervision of the health of individual industrial employees, and of the valuable information and results which have been obtained from the introduction by private employers of a medical service for their establishments, all employers, including Governments, should be encouraged to provide an efficient and regular medical service which shall keep under review the health of the workers and shall inquire as to any relation between variations in health and conditions of employment. Moreover, in order to secure the greatest amount of public benefit from this measure, records of work done should be kept in a standardized method.

It will be gathered that in 1922 Australia had not advanced as other countries had done in the direction of safeguarding the workers from ill effects of trade processes, unfavorable industrial environment, or exploitation by grasping employers.

In 1924 the second conference passed a series of important resolutions dealing with the restriction of employment of children and female adults under specified conditions, with the question of weight lifting by children and women, with the setting up of standards in regard to such matters as rest rooms and sitting accommodation in trades, luncheon rooms and dressing rooms, ventilation, illumination, qualifications for inspectors of factories, and the notification of certain named industrial diseases, including lead poisoning. The conference determined to induce the parliaments of the several states to render uniform the legislative basis of factory and industrial life. It was further resolved to endeavor to obtain statistical information concerning morbidity and accidents among factory and workshop workers. At the third conference, held in 1927, records of considerable progress were registered. Among the resolutions adopted at this conference was one appointing a committee to investigate the question of accidents among minors engaged at factories. A great deal of general work was accomplished and fresh ground was broken. It was determined to institute a survey of female labor in industry.

A perusal of the reports of these conferences and of the communications made from time to time by the Commonwealth Division of Industrial Hygiene and by the officers in charge

of this work in the states reveals that as far as the central authorities are concerned the matter has scarcely progressed beyond the stage of collection of information. The fact that there is so much to learn renders it essential that full information should be collected before any attempt is made to enforce regulations or standards by law. It is further to be noted that the findings of the conferences were not necessarily adopted by the responsible ministers and that but little legislation has so far been introduced. Where it was found that the measures recommended could be prescribed by regulations under existing Acts, some progress has been made.

In the course of the six years of its existence the Division of Industrial Hygiene has enlisted the services of the Commonwealth statistician for the purpose of the compilation of morbidity statistics of the several government departments and private industries. Excellent progress has been made in this colossal undertaking. The Division has issued several valuable service publications dealing with the scope of industrial hygiene, health hazards in industry, ambulance rooms, the hygienic aspects of the Factories and Shops Acts, the prevention of accidents, morbidity statistics among school teachers and among men engaged on the New South Wales and Victorian railways, and some matters in connection with the woodworking industries.

After the establishment of the Division of Industrial Hygiene by the Commonwealth Department of Health and the creation of an amicable understanding between the state authorities and the Division, complemental activities have been established in some of the states. In 1923 the Department of Public Health of New South Wales appointed a medical officer of industrial hygiene. Dr. C. H. Badham, the holder of this office, has carried out some highly useful work. The most important is an investigation into the standard of air movement in textile mills necessary to produce comfort. It was found that the standards set up by Dr. Badham could for practical purposes be accepted for many other industries. Recently he has extended his work to theaters and picture palaces. It must be remembered that the climate of Australia varies very widely. In the extreme south, namely in Tasmania, the temperature and rainfall are not dissimilar to those of England. In the extreme north the conditions are tropical. Along the east coast the humidity is high and the summer temperatures are also high. Very hot atmosphere is met in the west of the eastern states, New South Wales and Queensland, while in Western Australia the variation ranges between dry heat of a moderate degree in the south to tropical mugginess at Broome and other places in the north. The question of climate thus forms a series of special problems for the industrial hygienist in Australia.

The Commission of Health in Victoria has appointed a special officer who is at the disposal of the Department of Labour. This officer deals with all matters concerning the health of the workers.

It is unnecessary to deal severally with the numerous official inquiries

that have been held at the instigation of the state authorities during the past ten years. The subjects handled include pulmonary tuberculosis, pneumonokoniosis, lead poisoning in miners and in paint makers and users, the hygiene of the clothing trade and of the printing industry, the conditions obtaining in flour mills, the health of school teachers, and the health of the employees in government departments.

Trade-Unions and Health Conditions

Australia has been described as the workingman's paradise. He relies on many factors in order to obtain his desires. In the first place the federal courts deal with awards; demands for a higher minimum and for improved conditions can be brought before the federal court, if the state court gives an award that proves unsatisfactory. Some trade-unions have acquired much skill and have developed much acumen in playing the one court off against the other. In the next place the living wage is determined officially by a commission, and capital has been made out of the fact that the basic wage up to a short time ago was based on the assumption that every worker was married and had on an average two children. The unmarried worker claimed and obtained this basic wage and the addition prescribed above it in the award of the federal court. It is common knowledge that, notwithstanding the establishment of arbitration courts, strikes are commoner in Australia than elsewhere and even deregistration of a union does not obviate the menace of strikes and slowing down of production. Stop work meetings take place, despite the protest of the employers. In certain industries there is a continuous and bitter strife between the men and the owners, the coal and other mines and the shipping and wharf trades being the most militant. On the other hand it must be recognized that in the main the primary claims of the unions are fair and are based on the right of human beings to live and work decently and in safety. In some trades the masters are willing to concede reasonable terms and conditions and in these trades strife does not exist.

Matters concerning the protection of the worker against trade hazards are dealt with by the arbitration courts when an application for fresh awards is under consideration. Unfortunately the governments themselves do not set an example in this regard. The governments in Australia engage in trade. The Government Printer is in open competition with the private printer; the Commonwealth government had its fleet of ships and engaged in passenger and freight trade. Governments have fish shops supplied by government trawlers, meat shops, and so on. The health authorities control restaurants and eating houses, hotels, and places where foodstuffs are exposed for sale. The control on the whole is passable, but there is room for improvement. The markets are often in a very dirty condition.

Summing up this part of the subject it may be accepted that the several trade-unions seek hygienic conditions better than those provided and in this respect their demands should be encouraged.

Royal Commission on Health

In 1926 an important Royal Commission was appointed by the federal government to inquire into public health as a matter for legislation and administration by the Commonwealth of Australia in conjunction with the states where necessary. One of the subjects specially mentioned in the terms of reference is industrial hygiene. The commissioners made a very exhaustive inquiry into the state of affairs in all parts of the Commonwealth and in due course issued a most valuable report, the text of which was published in *The Medical Journal of Australia* of Jan. 16, 1926. In the course of their report the commissioners set up a scheme for the co-operation of the practising members of the medical profession with the health authorities and indicated in broad terms the manner in which this assistance by individual doctors could be carried out with advantage to the community. One of the recommendations of the commissioners was to the effect that a federal health council should be formed of representatives of the Commonwealth and state departments of health. This council has come into being and is working effectively and well. It takes into consideration all matters affecting the health of the community, including those concerned with industry. The section of the report dealing with industrial hygiene is as follows:

IX.—Industrial Hygiene

1. The phase of public work referred to by the term "industrial hygiene" embraces action taken for the prevention of sickness and accident in industry and aims at the guidance of the development of industry along hygienic lines and at improving generally the health conditions of the workers. Until recent years the action taken in Australia with respect to industrial hygiene has been limited to legislation concerning space, sanitary accommodation and ventilation of factories and workshops, with some restriction on the age of employees; ventilation and safety in mines and the mitigation of the larger risks of certain occupations. As a result, however, of the increase of knowledge as to the causes of ill health, the subject of industrial hygiene has received greater attention. Numerous investigations which have been made in various countries have shown that the dangers and risks of certain occupations are in many cases preventible and it is gradually being recognized that not only can a large proportion of disease, ill health and accidents be eliminated, but that production can be greatly increased by the provision of means for the protection of the worker.

Present Conditions

2. Conferences on the subject of industrial hygiene between officials of the Departments of Health of the States and Commonwealth, with representatives of State Departments of Labour or Factories, were held in 1922 and 1924 respectively, at which the subject was considered with the view of arriving at uniformity of practice in certain respects. A number of resolutions were passed by the conference of 1922 having as their object the securing of uniform action in each State, as to the examination of employees, keeping of records, minimum age of employment, collection and publication of information, appointment and qualification of factory inspectors, legislation, morbidity statistics and provision of medical services by employers. Although it is too soon yet to expect any material change, certain recent developments have been noted. Among them may be mentioned the following: In New South Wales a Medical Officer of Industrial Hygiene was appointed in 1923 to the Department of Health for the purpose of investigating working conditions and making examinations of employees in industries and regulations under

the *Public Service Act* were issued in 1924 governing the appointment of cadets and factory inspectors and outlining the educational and technical qualifications necessary for appointment and promotion. In Victoria regulations under the *Health Act* were issued in 1923 requiring notification of certain occupational diseases. In the same State a medical officer of the Department of Health was in 1923 placed for a portion of his time at the disposal of the Labour Department for the purpose of investigation of any medical condition and in October, 1925, a female medical inspector of factories was appointed to the latter Department for the purpose of exercising closer supervision over female and child workers collectively and individually. In Western Australia an amendment of the *Factories and Shops Act* was passed in 1923 in which provision was made for the regulation of factories where lead, mercurial or arsenical preparations are manufactured. In the same State the *Workmen's Compensation Act* was amended in 1924 to provide that where workers are affected by certain specified industrial diseases (twenty-three in number), they shall be entitled to compensation as if the disease were a personal injury by accident. At the same time the diseases referred to were made notifiable. Arrangements have recently been made by the Commonwealth Department of Health with a number of firms for the keeping of records on prescribed lines and information is being accumulated for future use.

Morbidity Amongst Workers

3. A considerable number of witnesses was examined by us on this subject. It appears from the evidence that comparatively little information is available as to morbidity amongst workers, owing to the fact that no legislation is in force requiring the notification of sickness other than certain infectious diseases or the recording of illnesses by the companies or firms concerned. An inquiry made by Dr. D. G. Robertson, Director, Division of Industrial Hygiene, Commonwealth Department of Health, into the sickness experience of 95,244 officers in various departments of the Government services of the Commonwealth and the States of Victoria and New South Wales for the years 1920–1923 showed that during those years the total number of days lost by male officers, of whom there were 70,741, was 479,685, or an average of 6.8 days *per annum* per employee. Of the female officers, 24,503 in number, the total number of days lost was 277,677 or an average of 11.3 days *per annum* per employee. The average loss of time by male and female employees was 7.9 days *per annum*. The loss of time due to epidemic or infectious diseases was 24%, injuries 21.3%, digestive diseases 21.5%, respiratory diseases 12.3% and diseases of the nervous system 8.8%.

Medical Services in Industry

4. With regard to the provision of medical services by employers the evidence submitted by Dr. D. G. Robertson showed that from inquiries made, one company engages a full-time medical officer, twenty-one companies each employ a part-time medical officer, five companies have the services of a medical officer through medical funds and twenty-one other firms have physicians available in cases of emergency. At least twenty-two firms employ qualified nurses to look after the workers and six other firms employ unqualified nurses for this purpose. It was further stated that fifteen firms provide both an ambulance room for the treatment of injuries and a dispensary where the usual remedies are kept and that thirty-two other firms have an ambulance room and five provide dispensaries. In all fifty-two firms are known to have made some provision for the medical care of their employees.

The activities of the cooperative council of the Electrolytic Zinc Company of Australasia, Limited, in endeavouring to improve the health of the employees of the company, illustrate what can be accomplished in this direction and especially by the establishment of a dental clinic. The cooperative council of the company considered that this clinic has undoubtedly resulted in improved health conditions and concurrently has also promoted happiness and efficiency.

5. From the evidence given by various industrial medical officers it would appear that their duties vary considerably. In

some cases applicants for employment are not examined before engagement; in others the conditions under which employees work are not supervised. In all cases, however, small ailments and accidents and illnesses occasioned by the employment are attended to and in some cases measures are instituted to prevent the recurrence of ill-health. In some instances the supervision by medical officers and nurses includes advice to the employees to consult their medical attendants or a dentist or to go to a hospital and as every case of ill-health is reported, the conditions of the work are examined and defects as far as possible remedied. In some firms a transfer to some other section of the establishment is arranged if ill-health is the result of standing or is due to some other special cause of fatigue.

6. Most of the witnesses on this subject were agreed that there was need for training of medical practitioners who propose to engage in industrial medical work. The majority of those now engaged in this work have gained their knowledge from experience and the suggestion was supported by several witnesses that industrial medical training should be included among the subjects dealt with by the chair of preventive medicine, which we have recommended should be established. Several witnesses advocated propaganda among persons engaged in industrial occupations. It was proposed that among other methods short and suitably worded notices might be displayed in all industrial establishments, as is already done in some, pointing out the necessity for care and how to avoid risks and dangers.

Standards of Health in Industry

7. The inquiry conducted by Professor Chapman into the Broken Hill mining industry, where over seven thousand miners were examined, convinced him that the hygienic standards of Europe and other countries are not applicable to persons in this country and that there is a need for an Australian standard of health. For this purpose a complete physical survey of every individual in certain industries is necessary. Up to the present medical examination has taken place only in certain industries in which there is a special risk. It would help greatly if a similar examination could be made of workers engaged in industries in which there is no special risk. Another witness, Dr. S. A. Smith, also expressed the opinion that a survey of industrial groups in Australia is essential in order to lay down standards of health in Australia. He was of opinion that the investigation should be made by a staff including an expert physiologist. Such an investigation would be a favourable starting point for a proper system of industrial hygiene in Australia and would point the way to modifications in working conditions which would tend to improve the health of men engaged in dangerous industries.

8. Comparatively little attention has so far been paid in Australia to the question of industrial hygiene. With the exception of the Broken Hill Royal Commission and of certain investigations into the health of stone masons, quarrymen, sewer miners and some branches of the clothing industry, there have been few well-defined or complete investigations to determine the industrial conditions in any industry or to correlate them to the health of the workmen.

Division of Industrial Hygiene

9. The Division of Industrial Hygiene of the Commonwealth Department of Health was initiated in 1921, when the Rockefeller Foundation loaned an expert medical officer in industrial hygiene to the Commonwealth for the purpose. This Division has been active in several directions and has published the following valuable service publications: "The Scope of Industrial Hygiene," "Health Hazards in Industry," "Industrial Accident Prevention" which have been widely circulated. The conferences of Commonwealth and State Health officials with leading officials of the State Departments of Labour or Factories already referred to, were held at the instance of this Division. The Director of the Division of Industrial Hygiene is a member of the Advisory Committee on Industrial Hygiene of the International Labour Office and in this way close touch is kept with all developments in the field of industrial hygiene in other countries. Expert advice is avail-

able to employers and employees and the work of the Division is likely to be of great value in guiding the development of industry along hygienic lines and improving generally the conditions of the workers. Assistance has been given to State Governments in connexion with several inquiries and investigations.

10. We are of opinion that the Division of Industrial Hygiene in the Department of Health has been organized on right lines in carrying out the following activities:

(*a*) the publication of service reports and information;
(*b*) the collection of data on mortality and morbidity;
(*c*) the encouragement of the organization of industrial welfare services, medical, dental and nursing among industrial companies or firms;
(*d*) the encouragement of routine medical examination of employees;
(*e*) the organization of uniform methods of records by industrial establishments;
(*f*) assisting State health industrial authorities and other bodies in investigations and inquiries into problems or difficulties in connexion with industrial hygiene

and that its work in these directions should be extended.

Recommendations

We recommend that—

(1) The work of the Division of Industrial hygiene in the Commonwealth Department of Health should be extended in the directions above indicated.
(2) Provision should be made at Universities for the training of medical practitioners in industrial medical work.
(3) A physical survey of individuals engaged in various industries should be made for the purpose of establishing Australian standards of health and that this should be carried out under the control of the Commonwealth Department of Health by a trained staff including an expert physiologist.
(4) The periodical conferences between Commonwealth and State officials with representatives of Labour and Factory Departments should be continued for the purposes of insuring uniformity with respect to records and further action on various other subjects of industrial hygiene.

In many other respects the investigations and recommendations of the royal commissioners have direct and indirect bearings on the subject of industrial hygiene. The Commission has been the means of establishing some measure of harmony between the heads of the state departments and the permanent medical officers of the Commonwealth departments. The extraordinary inertia manifested by some of the state authorities still constitutes a great obstacle to progress.

Other Legislative Measures

During the past half century there has been a gradual reform in the different parts of Australia in regard to the control of labor conditions. The long hours of the past, the exploiting of children and women, and the tolerance of unhealthy industrial environment have been exposed; and one by one the worst defects of uncontrolled labor have been remedied, at all events as far as the legislative basis is concerned.

The Factory Acts of the colonies were amended on many occasions during the last two decades of last century. In 1907 a definite attempt was made in Victoria to regulate the conditions of labor of children and women. In 1919 the Minister of Health was empowered to require the provision in factories in Victoria of dining rooms, bathrooms, rest rooms for female employees, and

first aid appliances where machinery is used. Previously restrictions had been introduced in regard to the maximum weight that girls under 18 were permitted to lift or carry. More recently occupiers of factories in Victoria have been compelled to provide suitable seating accommodation and to install efficient guards for machinery.

Similar laws were enacted in South Australia from 1894 onward. New South Wales was tardy in adopting the necessary legislation and the government of this colony in the early days refused to put into force the strong recommendations of a special committee appointed to inquire into the advisability of regulating the conditions of factories. Queensland fell into line toward the close of the century, while Western Australia and Tasmania followed suit soon after Queensland.

The early closing of shops, the limitation of the number of hours of labor, and the prescription of conditions under which overtime may be worked have been dealt with by acts, regulations, and awards. At the present time there is much confusion and a great deal of dispute arising from the fact that while the Federal Arbitration Court has accepted a forty-eight-hour week, the New South Wales court has adopted a forty-four-hour week, and in some industries even shorter hours of labor are recognized. In Victoria the longer week obtains. Generally speaking, employers have been compelled to accept the number of hours prescribed by the state courts when this is less than that of the Commonwealth court.

In New South Wales notice has to be served to the Department of Labour and Industry when women and children are required to work overtime. Tea money has to be paid and the Department has to be informed as to the reason why overtime is needed. The Acts in all states prescribe the minimum number of closets to be provided and contain clauses dealing with the requirements as far as ventilation, lighting, cleaning, whitewashing of walls, and the like are concerned. These provisions, however, are not strictly enforced and it is by no means infrequent to find crowded, ill-ventilated, and badly illuminated places used as factories and workshops.

The Workers' Compensation Acts in some of the states have recently been modified by the widening of the legal definition of the term industrial injury. In New South Wales and some other states compensation is payable to an injured worker who meets with an accident not only in the course of employment, but also when going to and coming from his work. The accident in respect of which compensation is claimable is not necessarily arising in the course of the employment or resulting from that employment, but may be incidental to it. A worker in New South Wales who is knocked over in the street while he is proceeding to work or returning from work can claim compensation, but the accident must occur in the direct route. If a man visited a public house before going home and became embroiled in a fracas, provided that he could prove that the injury was not the result of his own misconduct or carelessness and that it occurred at a place situated on the ordinary route of his return from work, his claim would probably be allowed. Certain diseases are included in the definition of injury. Moreover, com-

pensation is granted even if the worker has not exercised care in carrying out his duties or in moving from one place of work to another.

It is interesting to note that when the Workers' Compensation Act of New South Wales of 1926 was brought into action, few insurance companies were prepared to undertake the risks involved. A Government Insurance Office was therefore established and the premiums charged to employers were extremely high. After twelve months the houses that had issued policies under the Act found that the risks were materially lower than had been anticipated. Premiums were lowered and a great mass of business that had previously been given to the Government Insurance Office passed over to the private companies.

In other states the changes in the law have not been so drastic and in a few the worker is not adequately protected. The amounts paid in compensation have increased steadily during the past fifteen years and at the present time aggregate a substantial sum in relation to the industrial population. From the statistics published it appears that approximately 6.5 to 7 per cent. of employees sustain accidents in the course of their work which lead to disablement or death. In New South Wales there were approximately a quarter of a million workers employed in the year 1925 and of these approximately 20,000 met with accidents for which compensation was paid amounting to nearly a third of a million pounds sterling. In Victoria the numbers were about two-thirds of the New South Wales figures. In Queensland the total number of injuries in 1923 was just under 11,500, of which 146 were fatal and over 3,000 permanent injuries.

Injured workers are entitled to medical and nursing treatment under the Acts in New South Wales and Western Australia. In the former state the employer is liable for medical treatment at a cost of not exceeding £50, save in exceptional circumstances, and is required to cover the risk by insurance. Certain difficulties have arisen in this connection with the medical profession. It has been held that as the cost of medical attendance on an injured worker is defrayed by an insurance company and as it is specified that the employer is liable for the fees obtaining in the district, full private fees should be charged no matter what the financial position of the patient may be. At first the injured patient was required to demand from his employer that medical treatment be provided and when the employer failed to provide it, he, the injured worker, could obtain medical attendance. An amendment of the Act, however, has removed this necessity of applying to the employer; the injured worker can now obtain treatment, but he is liable for the cost and has to recover it from his employer or from the insurance office that has accepted the risk. An arrangement has been made between the medical profession and certain licensed insurance offices whereby the doctor is paid according to a fixed scale of fees. The rates are lower than those obtaining in general practice, but the medical practitioner has no difficulty in securing payment. In consequence the injured worker benefits inasmuch as he receives willing and efficient service. In Western Australia the provision of medical treatment

has offered no serious difficulty. In all other states the injured worker obtains his medical treatment either at the hospitals, through the agency of the friendly societies, or in some other way.

Disablement of short duration does not entitle the worker to compensation. In Victoria the period is one week, while in the other states it is three days. Some employers refuse to pay wages during this short period of disablement and the whole loss is borne by the worker. There is no compulsion on an employer to make any arrangement for the treatment of minor or major injuries, other than those that produce disablement beyond the period mentioned. In practice, however, the medical treatment in New South Wales and Western Australia in the case of serious injury causing incapacity of a more lasting nature commences from the time of the accident. Malingering undoubtedly occurs and exaggeration of disability is common. In these circumstances the limitation is a necessity and is not opposed by trade-unions.

Present Position of Industry in Australia

From the foregoing it will be seen that the legislative basis for the control of the health of the worker in Australia is gradually becoming better and more in conformity with English ideals. It is, nevertheless, incomplete and defective in many respects and many impediments have still to be overcome before the legislature in the several states will be persuaded to pass the essential amendments and fresh measures. But even if the basis were complete and satisfactory, it would be necessary to insure that the administration of the law is rendered efficient and uniform. In Australia with its seven authorities working under six sets of state laws and one set of federal Acts, the position is complex and artificially difficult. Federation has succeeded in rendering possible a co-ordination of effort, but in practice the states are still resisting the intrusion of the Commonwealth Department of Health into the arena of internal hygienic affairs.

While various standards are prescribed by law and employers are required to carry on their business in accordance with these standards, it is by no means an easy task to compel obedience. There are over 450,000 persons engaged in factories in the Commonwealth and approximately 700,000 persons employed in industry generally. Dr. D. G. Robertson, the director of the Division of Industrial Hygiene of the Department of Health, has stated that Australian employers and their managements are realizing in increasing numbers their responsibilities and are adopting standards far superior to those required by law. On the other hand a very large number of employers have failed to appreciate the true economic significance of industrial hygiene and continue to evade the law or to obey it to the letter and not intelligently nor with good intention. Industrial hygiene has unfortunately had a setback within the last few months in New South Wales. A big firm of silk stocking manufactures has gone into liquidation. This firm indulged in many extraordinary extravagances, a few of which were closely connected with the work of pro-

moting the welfare of the workers. For example, while rest rooms, rest pauses, recreation rooms, luncheon club, and other measures for the avoidance of fatigue and incapacity of the employees to work were provided, these measures were supplemented by the provision of a fleet of char-à-bancs and cars to convey the employees to and from their work. The main causes of the failure had nothing to do with the welfare work or with the introduction of reasonable protective measures for the safeguarding of the health of the employees. Those employers who regard the earning of large profits and the accumulation of surplus funds as the only objective of trade, and who use labor merely as a means to this end, point a finger of warning to this example, as if it provided evidence of the untruth of the contention that hygienic measures in industry tend to increase production as well as to improve the lot of the worker.

In 1923, 41 per cent. of the total number of factory employees were engaged at the 660 factories with 100 or more hands. There were 18,513 factories with less than 100 each, with an average of just under thirteen hands. In these early days, before employers are thoroughly convinced of the necessity to provide safeguards for and to look after the health of their employees in their own interests and before they realize their duties as citizens to contribute to the health and comfort of a section of the community, it is futile to expect that more will be effected at the small establishments than is enforced by law. It appears, however, that the managements of even the larger establishments are failing to a very considerable extent. In 1925 there were but fifty-one establishments at which medical practitioners or nurses or both were engaged. At twenty-three of these the duties of the former were limited to treatment of emergency illness or injury, leaving but twenty-eight establishments in the whole Commonwealth at which industrial hygiene in its modern conception was practised.

Full time medical practitioners are employed at five establishments, all governmental or departmental. In the New South Wales Railways and Tramways department there are three whole time medical officers, the Post Office employs one at Melbourne and one at Sydney, the Victorian Railways employ one medical officer, the Metropolitan Water and Sewerage Board in Sydney employs one medical officer, and a departmental store has one. Of the thirty establishments employing part time medical officers, eleven are governmental or municipal and two are gas companies.

Under the best conditions the duties of the industrial hygiene medical officer comprise supervisory work, the control of hygienic conditions of the working environment, the periodic examination of the employees and the examination of those seeking employment, lecturing on first aid, and the treatment of emergency illness and injury. In a very few places the medical practitioner advises the management in regard to the ventilation and lighting, is consulted on such matters as the sanitary arrangements, the provision of proper drinking fountains or marked glasses, the equipment of rest rooms recreation rooms, luncheon rooms, dressing rooms, and of first aid rooms, the selection of guards for machinery,

the measures necessary for the reduction or removal of dust, gases, and other noxious products, the plans for the reduction of heat, noise, and humidity, the provision of seats, of mats to protect the feet of workers in rooms with concrete flooring, or of foot rests, the advisability of applying floor coverings, the provision of bins and other receptacles to get rid of litter and untidiness, and the measures to be adopted to insure effective cleaning of the workrooms. In the course of his work he has the function of watching the workers and if necessary of suggesting the adoption of practical measures calculated to reduce fatigue. He makes a special study of processes that entail much repetition or that are usually effected in uncomfortable or constrained positions. He looks for evidence of excessive pressure on the abdomen in women leaning against parts of machines; he notes the effects of weight lifting on young persons and female workers and those of foot work. He stops practices likely to prove injurious, such as the licking of fingers or the putting of objects in the mouth. He makes inquiries concerning the meals that are consumed and doubles his vigilance when a woman worker manifests signs of nervousness or anemia. He forms an opinion concerning the suitability of each worker for his or her job and when he concludes that a particular worker is temperamentally or physically unfit for the work that he or she is doing, it is his duty to urge the management to find some other activity for which the worker may prove suitable. It might even be necessary for the medical officer to advise that the management seek some other occupation for a worker in another establishment. A few of the best medical officers have obtained the full confidence of the workers by judicious handling and by the adoption of a friendly attitude which is neither too familiar nor too commandeering. In some establishments the workers are given an annual holiday in addition to the statutory public holidays (nine days). The wise management gives a relatively free hand to the medical officer, keeps on good terms with the trade-unions concerned, and interprets the terms of the awards in a liberal sense, tending rather toward generosity than toward strict equity.

The question whether a medical officer employed by an industrial establishment should or should not treat injured workers or persons taken ill at the works has given rise to much discussion in Australia. The medical profession as a whole has maintained that medical attendance in its ordinary sense is a matter between a person and the medical practitioner chosen by him for the purpose. On the other hand the employer who engages a practitioner to carry out duties on his behalf is held to stand in the relation of a third party and has no right to intervene between a doctor and his patient. In 1925 the Federal Committee of the British Medical Association in Australia at the request of the Victorian branch undertook to draw up a model form of agreement between industrial hygiene medical advisers and employers. At the same time it resolved that treatment by industrial hygiene medical advisers on employees was to be restricted to first aid. At the next meeting of the Committee the members were referred

to the rules of the British Medical Association in regard to medical practitioners called upon to examine patients under the care of other medical practitioners. These rules are intended to apply to examiners required by third parties, such as insurance offices, employers, and the like. They do not apply to certifying factory surgeons. The rules prescribe the procedure and specify that the duty of the examining practitioner is to be confined to examinations. In other words, no treatment is permitted. The Federal Committee determined to seek information concerning the terms of the contracts made between industrial hygiene medical officers and employers of labor and concerning the conditions of employment when the attendance is given without contracts. It was set out that the object of the inquiry was to secure uniformity and protection of members carrying out this kind of work. At the next meeting of the Federal Committee on Feb. 3, 1926, a draft model agreement was submitted. The draft was referred to the several branches of the British Medical Association in Australia.

In order to make the matter clear, it is necessary to regard the contract as being composed of two parts. The first part deals with the remuneration and hours of service. The second part defines the duties. It is obvious from the terms of the agreement that it was anticipated that the majority of the industrial hygiene medical officers would be part time officers. This means that the representative organization of the medical profession was content to accept the existing conditions and did not regard it as its duty to influence the medical profession to establish an ideal service. At this stage employers still seem to resist the suggestion that whole time medical officers should be appointed in all large concerns and that both from the economic and from the humanitarian points of view it is necessary to expend considerable sums of money to improve the hygienic conditions of labor.

The branches of the British Medical Association accepted the draft model agreement without comment and instructed their representatives to fix the minimum rate of remuneration. In September, 1926, it was resolved that the minimum remuneration for the work should be not less than 1 guinea per hour or part of one hour. One proposal was put forward that the rate of remuneration should be $1\frac{1}{2}$ guineas per hour, 3 guineas for half a day of three hours, or 5 guineas for a day of six hours. It is not suggested that £1,365 *per annum* is too much for a whole time medical officer, calculated at 5 guineas for five working days each week, but the implication of the proposal is that the industrial hygiene medical officer need not attend during the whole time of the working week. Thirty hours a week is given as full time employment for the medical practitioner, while forty-four or forty-eight hours comprise the working week for the factory or workshop employees. In the next place it was frankly stated that this work would be carried out by general practitioners and that only rarely would they make a special study of industrial hygiene. Specialists trained for the work would command higher rates of salary. The determination of the Federal Committee thus resolves itself into the

demand for a very limited part time service by practitioners not specially qualified to render this service at a relatively high rate of remuneration. It is contended that this action on the part of the medical profession cannot but retard the development of industrial hygiene in Australia.

In regard to the second part of the contract the duties are defined as follows: the medical examination of applicants for employment, the medical examination of employees at stated periods, the medical examination of employees reported to be sick and the giving of certificates as to fitness of employees to resume work, the immediate symptomatic treatment of employees taken ill or found to be suffering from indisposition at the place of work, the immediate, first aid medical attendance at the place of work on employees injured by accident, the periodic inspection of all buildings and working places with a view to the establishment and maintenance of a high standard of sanitation and hygiene, the investigation of occupational diseases existing among employees and of their causes and remedies, the supervision of first aid ambulance work, rest rooms, dental clinics, and welfare arrangements generally, the specification of the duties of nurses' first aid and ambulance attendants, the advising of employees as to the observance of rules of health and the issuing of reports to the managements on the working conditions in relation to the health of the employees, sanitation and water supply, and so on. If it is assumed that these duties could be performed satisfactorily in two or three hours a week by a practitioner not specially trained in industrial hygiene, the employers will have cause to mistrust the medical profession within a short time. It will be noted that the examination of employees reported to be ill has for its object the determination of the fitness of the employee to resume work. Unless the worker is convinced of the value of the medical examinations and medical control in the factory, the breach between the employer and the employed will widen and it will become impossible to apply the principles of industrial hygiene in its modern form. The object of the medical examination of a worker said to be ill should be primarily to ascertain the nature of the illness and to determine whether or not the illness necessitates absence from work. This may appear to be a small matter, but it is obviously of considerable importance from the point of view of the psychologic effect on the workers.

The matter of the treatment of employees at industrial establishments became somewhat complicated on the introduction of the amending Acts of the Workers' Compensation Act, 1926, 1927, in New South Wales. In view of the obligation on employers to be responsible for the cost of treatment of injuries and certain illnesses and of the statutory provision that, except when special permission is granted, all employers must insure against all claims under the Act, the medical profession in the state determined to charge full fees for this work. The New South Wales branch of the British Medical Association adopted a resolution to the effect that payment for treatment must be by fee and not by salary. Contract practice with the friendly societies was specifically excluded from this arrangement. It

soon transpired that a few practitioners who were engaged by industrial firms to act as part time medical officers were invited in the early days by the employers and more recently by the injured workers to give continued treatment. As the employer was responsible for the payment, it was found to be economical to enter into an arrangement with the industrial hygiene medical officer to give treatment at certain stated hours to as many workers as could attend. The medical officer held that it was reasonable and remunerative to charge a fee for each hour's attendance. At first it appeared as if the medical profession was determined to place as many obstacles as possible in the way of the development of this aspect of industrial hygiene. Later, however, it was recognized that no objection could be raised to this arrangement, provided that the medical officer did not undertake treatment for a salary and provided that he refrained from using his position as industrial hygiene medical officer to attract medical practice from other practitioners.

Hospitals and Philanthropic Institutions

Hitherto neither the public hospitals nor those organizations that are concerned with the care of the incapacitated have been involved in the development of industrial hygiene in Australia. The injured worker naturally is free to seek medical and surgical treatment at a hospital and if the disability is of long standing, or is permanent, he may obtain relief through the eleemosynary institutions established for the purpose. At the present time the application of the doctrines of preventive medicine has not reached the hospitals and in consequence the industrial hygienist finds it useless to turn to the public hospitals for collaboration. It is, of course, evident that treatment may be regarded as part of the plan of prevention and that the rapid return of an incapacitated worker to normal health and working ability is an important phase of industrial hygiene. Hospital physicians and surgeons, however, rarely if ever include in their treatment of an injured worker the giving of advice in regard to the form of work that he is capable of pursuing with advantage to himself and to his employer.

One result of the Technical Commission of Inquiry into the conditions of the mines of Broken Hill, to which reference has already been made, was the establishment of a bureau whose function has been to examine every worker at the commencement of his employment and to control the health conditions of those exposed to silica and to lead. For a short time this bureau undertook an experiment of placing miners found to be suffering from pneumonokoniosis with or without tuberculosis in suitable occupations in a district on the irrigation area in the south of New South Wales. The experiment was a partial success. Men who otherwise would have gone down hill rapidly, as a result of their physical condition being aggravated with a life of idleness and indulgence, have been kept in a state of relative health while occupied on the land under health giving conditions. Unfortunately the experiment was continued for but a short time and for many months the miners discharged from the

Broken Hill mines and compensated on account of pneumonokoniosis are permitted to swell the number of the unemployable.

The physical reeducation scheme inaugurated by the Department of Defense and the Department of Repatriation immediately after the war has not been developed in civil life. Some admirable orthopedic work is carried out by specialists and in the ordinary course of events a large proportion of this work reaches the industrial employee. It cannot be claimed that this work is primarily designed for the industrial worker, nor has a special branch been devoted to the problems of industrial hygiene.

Conclusion

Industrial hygiene in Australia is still in its infancy. Its beginnings have arisen from the action of the Department of Health of the Commonwealth. The employer is slow to grasp the fundamental conception of this relatively new science and does not yet realize that it is in his own interests to adopt its principles in order to increase production, to improve the mental attitude of the worker, and to create in him a spirit of willingness and eagerness for his job. Until the master recognizes that his man is a human being like himself and that he has no moral right to sacrifice working power, health, and life in his anxiety to gain wealth, progress will be slow. A good start has been made and it is merely a matter of time before the mass of employers are guided by the illative influence and adopt the wise course that will bring health, efficiency, and happiness into the workshop.

BOOKS RECEIVED

Books received are acknowledged in this column, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interest of our readers and as space permits.

Economics: Principles and Interpretation. By *Roy Emerson Curtis*, Ph.D., Professor of Economics in the University of Missouri; Formerly Edmund C. Porter Professor of Economics in Knox College. Cloth. Pp. xviii, 879 with index. Chicago and New York: A. W. Shaw Co., 1928.

Goiter Prevention and Thyroid Protection. By *Israel Bram*, M.D., Author of "Goiter; Non-Surgical Types and Treatment;" Medical Director, Bram Goiter Institute, Upland, Pa.; formerly Instructor in Clinical Medicine, Jefferson Medical College, Philadelphia; Fellow of the American Medical Association, the Association for the Study of Internal Secretions, the American Association for the Study of Goiter, the American Medical Editors' Association, etc. Cloth. Pp. 327 with illustrations, appendix, and index. Philadelphia: F. A. Davis Co., 1928.

Fundamental Gymnastics. The Basis of Rational Physical Development. By *Niels Bukh*, Principal, Gymnastic Peoples College, Ollerup, Denmark; Author of "Primary Gymnastics," etc. Translated from the second Danish edition, rearranged and adapted for use in America, by Emily Russell Andrews, Instructor in the theory and practice of gymnastics and self-testing activities; Central School of Hygiene and Physical Education, New York City; Instructor in theory of Fundamental Gymnastics, American Summer Courses, Ollerup, Denmark; and Karen Vesterdal, formerly, Assistant Instructor in gymnastics and folk dancing, Central School of Hygiene and Physical Education, New York City; Instructor of Song Games, American Summer Courses, Ollerup, Denmark. Cloth. Pp. xxiii, 202 with appendix and illustrations. New York: E. P. Dutton & Co., 1928.